REMARKS

With entry of the foregoing amendments, claims 1, 3 and 5-28 are now pending in this application. In the prior office action, the Examiner rejected claims 1-17 and 19-24. Claims 1, 10, 11, 15 and 18-24 have been amended. Claims 2 and 4 have been canceled with the features of the canceled claims being incorporated into amended claims 1 and 10. Claims 25-28 have been added. No new matter is introduced. Reconsideration is respectfully requested.

Allowable Subject Matter

The Applicants thank the Examiner for indicating that claim 18 would be allowable if rewritten in independent form. Claim 18 has been rewritten in independent form. Applicants believe that claim 18 as now amended is in condition for allowance.

Amendments to the Specification

The specification has been amended to correct typographical errors in certain mathematical equations.

The specification has also been amended such that "Figures 8(a) and 8(b)" are now recited as "Figures 8A and 8B."

No new matter is introduced by these amendments.

Claim Objections and Formalities

Applicants thank the Examiner for identifying typographical errors in claims 15 and 19. Appropriate amendments have been made to correct these errors.

Claims 1 and 10 have been amended for proper antecedent basis.

Claims 11, 19, 20, 23 and 24 have been amended to refer to the interference in the demodulated non-orthogonal pilot signal as the "pilot signal interference" and the interference in the demodulated data signal as the "data signal interference."

Claims 19-22 have been amended to correct typographical errors.

Claim Rejections - 35 U.S.C. § 102

The Examiner rejected claims 1-10 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent 6,067,292 to Huang et al ("Huang").

According to one aspect of the invention as recited in amended claims 1 and 10, a method and apparatus is provided that encodes data channels with a non-orthogonal pilot signal for wireless data transmission. Specifically, claims 1 and 10 have been amended to incorporate the features of claims 2 and 4, now cancelled, to clarify that both the method and apparatus for encoding data channels for wireless transmission include "generating a non-orthogonal pilot signal by modulating a pilot signal using a pilot channel code that is non-orthogonal to other codes used to modulate other channels" and then "producing resultant signals by summing the non-orthogonal pilot signal with a mixed data signal." Support for these amendments can be found at least in Figs. 2 and 3 and in the specification on page 8, lines 18-25, page 12, lines 10-18, and page 12, line 25 through page 14, line 3. As a result, one or more orthogonal channels may become available for user traffic, resulting in an increase in system capacity and greater data transmit rates.

The Examiner is of the opinion that Huang discloses this feature. Applicants respectfully disagree. Huang only discloses a wireless transmitter that encodes data and pilot signals over orthogonal channels. Specifically, Huang discloses spreading the data and pilot signals over channels that are orthogonal through the use of orthogonal Walsh codes. (Huang, Fig. 1; col. 3, ln. 31 through col. 4, ln. 14). Thus, Huang does not teach or suggest a transmitter that encodes data signals with a non-orthogonal pilot signal at all.

The Examiner is also of the opinion that claim 15 of Huang discloses encoding data channels with a non-orthogonal pilot signal. In particular, claim 15 recites a CDMA receiver "wherein the pilot channel is non-orthogonal to a desired user signal channel for a given path." However, claim 15 does not teach or suggest encoding data channels at a transmitter with a non-orthogonal pilot signal. Rather, Applicants contend that claim 15 is merely directed to a pilot signal being non-orthogonal due to multipath dispersion, which is the only context in which Huang discusses non-orthogonal pilot signals.

Specifically, Huang discloses a wireless receiver for cancelling pilot signal interference due to multipath dispersion. In other words, the receiver removes delayed versions of a pilot

signal from a composite signal for a given transmission path to obtain the transmit data more accurately. (Huang, col. 2, lns. 1-11). Huang further discloses that pilot signals are designed to be orthogonal to user data channels in order to avoid interference. Huang merely acknowledges that if there is multipath dispersion, there will be interference due to a variety of multipath components which are not orthogonal to the desired signal, including multipath components of a pilot signal. (Huang, col. 1, lns. 48-61).

For at least these reasons, Huang does not disclose encoding a data channel with a non-orthogonal pilot signal at a transmitter. At best, Huang merely acknowledges that multipath dispersion may cause multipath components of a pilot signal to be non-orthogonal with a desired data signal.

Thus, claims 1 and 10 are novel and non-obvious in view of the prior art of record and are believed to be patentable.

By virtue of at least their dependency to amended claim 1, claims 3, 5-9 are also believed to be patentable.

Claim Rejections - 35 U.S.C. § 103

The Examiner rejected claims 11-17 and 19-24 under 35 U.S.C. § 103(a) as being unpatentable over Huang in view of U.S. Patent 5,764,687 to Easton.

According to another aspect of the invention, a method and apparatus is provided that decodes data channels using data channel interference cancellation. As now recited in amended claims 11, 23 and 24, the method and apparatus involve receiving a composite signal that includes an original data signal encoded with an original non-orthogonal pilot signal. The composite signal is demodulated into a demodulated data signal and a demodulated non-orthogonal pilot signal. Each of these signals includes interference. The data signal interference is introduced into the original data signal as a result of the data signal being encoded with the non-orthogonal pilot signal. The pilot signal interference is introduced into the non-orthogonal pilot signal during the demodulation process.

In order to recover the original data signal, the data signal interference must be removed. To accomplish this, the pilot signal interference is first removed from the demodulated non-orthogonal pilot signal in order to regenerate the original non-orthogonal pilot signal. (See

specification, page 15, line 11 through page 16, line 24). Then using the reconstructed non-orthogonal pilot signal, data signal interference terms that represent the data signal interference in the demodulated data signal are generated. Specifically, the data signal interference terms are derived from the regenerated non-orthogonal pilot signal. For example, where the data and pilot signals are modulated using QPSK, the data signal interference terms are expressed as equations 14-17 (See specification, pages 17, line 7 through page 18, line 17). The resulting data signal interference terms are then removed (i.e. subtracted) from the demodulated data signal in order to cancel the data signal interference.

In contrast, Huang discloses a CDMA receiver that detects and removes pilot signals of interfering multipath components of a received signal. (Huang, "Abstract"). Specifically, to remove the pilot signal interference for a given path, multipath versions of a transmitted pilot signal are reconstructed and then only the reconstructed pilot signals are subtracted from either the received signal in a pre-accumulation embodiment or from demodulated pilot and data signals in a post-accumulation embodiment. (See col. 2, lns. 24-37; Fig. 6, col. 7, ln. 45 - col. 8, ln. 21; and Fig. 14, col. 11, lns. 5-35). Huang does not teach or suggest generating data signal interference terms that are derived from a reconstructed non-orthogonal pilot signal and then subtracting the data signal interference terms from the demodulated data signal to remove the interference.

Furthermore, although not disclosed in the specification, Huang recites in claim 15 that where the pilot signal is non-orthogonal to a desired user signal channel for a given path, "each demodulator generates L-1 pilot cancellation signals and an additional cancellation signal for cancelling out the non-orthogonal pilot signal of its own multipath component prior to its demodulation, the cancellation of the non-orthogonal pilot signal occurs by using an additional subtraction in each of the L subtraction means." (Emphasis added) At best, claim 15 suggests removing multipath components of a pilot signal that are not orthogonal to a desired data channel.

Claim 15 does not further teach or suggest "generating data signal interference terms that represent the data signal interference in the demodulated data signal, the data signal interference terms being derived from the regenerated non-orthogonal pilot signal" and "removing the data

signal interference terms from the demodulated data signal" as now recited in claims 11, 23 and 24.

Easton also does not teach or suggest this feature. Rather, Easton discloses a mobile demodulator architecture for a spread spectrum multiple access communications system. Specifically, Easton discloses multiple demodulator front ends for demodulating multiple instances of a spread spectrum signal at the chip rate and a symbol processing system for processing each demodulated instance of the spread spectrum signal at its transmitted symbol rate in a time-divided manner.

For at least these reasons, claims 11, 23 and 24 are novel and non-obvious, and thus are patentable.

Furthermore, by virtue of at least their dependency to claims 11 respectively, claims 12-22 are also believed to be patentable.

New Claims 25-28

Claims 25 and 26 are directed to a method and apparatus of encoding data channels that involves (i) modulating a data signal onto a data channel; (ii) modulating the pilot signal onto a pilot channel, such that the pilot channel is non-orthogonal to the data channel, resulting in a non-orthogonal pilot signal; and (iii) combining the non-orthogonal pilot signal and the modulated data signal into a composite output signal that is capable of transmission over a wireless medium. Support for claims 25 and 26 can be found at least in Figs. 2, 3, 8A and in the specification as originally filed on page 8, lines 18-25, page 12, lines 10-18, and page 12, line 25 through page 14, line 3.

Claims 27 and 28 are directed to a method and apparatus of decoding data channels that involves (i) receiving a composite signal, the composite signal comprising an original data signal encoded with an original non-orthogonal pilot signal; (ii) demodulating the composite signal into a demodulated data signal that includes data signal interference, the data signal interference being introduced into the original data signal as a result of the original data signal being encoded with the non-orthogonal pilot signal; (iii) demodulating the composite signal into a demodulated non-orthogonal pilot signal that includes pilot signal interference, the pilot signal interference being introduced into the non-orthogonal pilot signal during demodulation; (iv) removing the pilot signal interference from the demodulated non-orthogonal pilot signal in order to regenerate

the original non-orthogonal pilot signal; (v) generating data signal interference terms that represent the data signal interference in the demodulated data signal, the data signal interference terms being derived from the regenerated non-orthogonal pilot signal; and (vi) removing the data signal interference terms from the demodulated data signal. Support for claims 27 and 28 can be found at least in Figures 2, 4-6, 8B and in the specification on page 14, line 4 through page 18, line 17.

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

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